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Patrick et al.

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[54] **MEDIA HANDLING IN AN INK-JET PRINTER HAVING GUIDE RIBS**

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[73] Assignee: **Hewlett-Packard Company**, Palo Alto, Calif.

[21] Appl. No.: **526,728**

[22] Filed: **Sep. 11, 1995**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 396,801, Feb. 28, 1995, Pat. No. 5,527,123.

[51] **Int. Cl.**[6] **B41J 13/10**

[52] **U.S. Cl.** **400/642**; 400/645.1; 271/188

[58] **Field of Search** 400/642, 645, 400/645.1, 645.3, 645.4, 647.1; 271/188, 190

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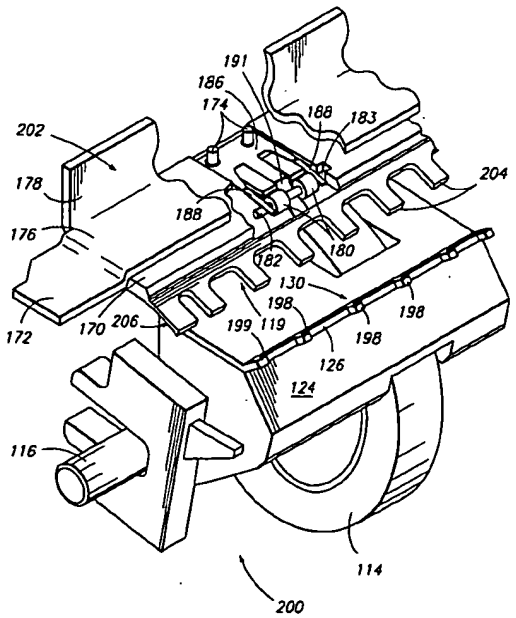
Hewlett–Packard Patent Application, Ser. No. 08/056,229, Filed Apr. 30, 1993; "Improved Media Control At Ink–Jet Print Zone".

Primary Examiner—John S. Hilten

[57] **ABSTRACT**

Described herein is a printer having a printhead which traverses laterally across a sheetlike print medium and which thereby defines a laterally-extending print zone across the print medium. A paper transport mechanism in the printer has drive rollers and associated pinch wheels to drive the print medium through the printer's print zone. The paper transport mechanism further includes an upper print media guide and a lower print medium guide. The two print medium guides are shaped at their transverse ends to bow the transverse edges of the print medium downwardly to reduce its tendency to buckle upwardly into the printhead. In order to fit the upper print medium guide into the limited available space above the drive rollers, it is made of a lower molded portion for paper contact and an upper backing portion for rigidity. A pinch finger extends toward the printer's print zone beyond the pinch wheels to establish a pinch point against the drive roller in near proximity to the print zone. To facilitate ejection of printed pages, the upper print medium guide is formed with a series of ribs which contact the paper. The ribs reduce friction and static buildup, and make it easier to push the paper from the paper transport mechanism.

12 Claims, 6 Drawing Sheets



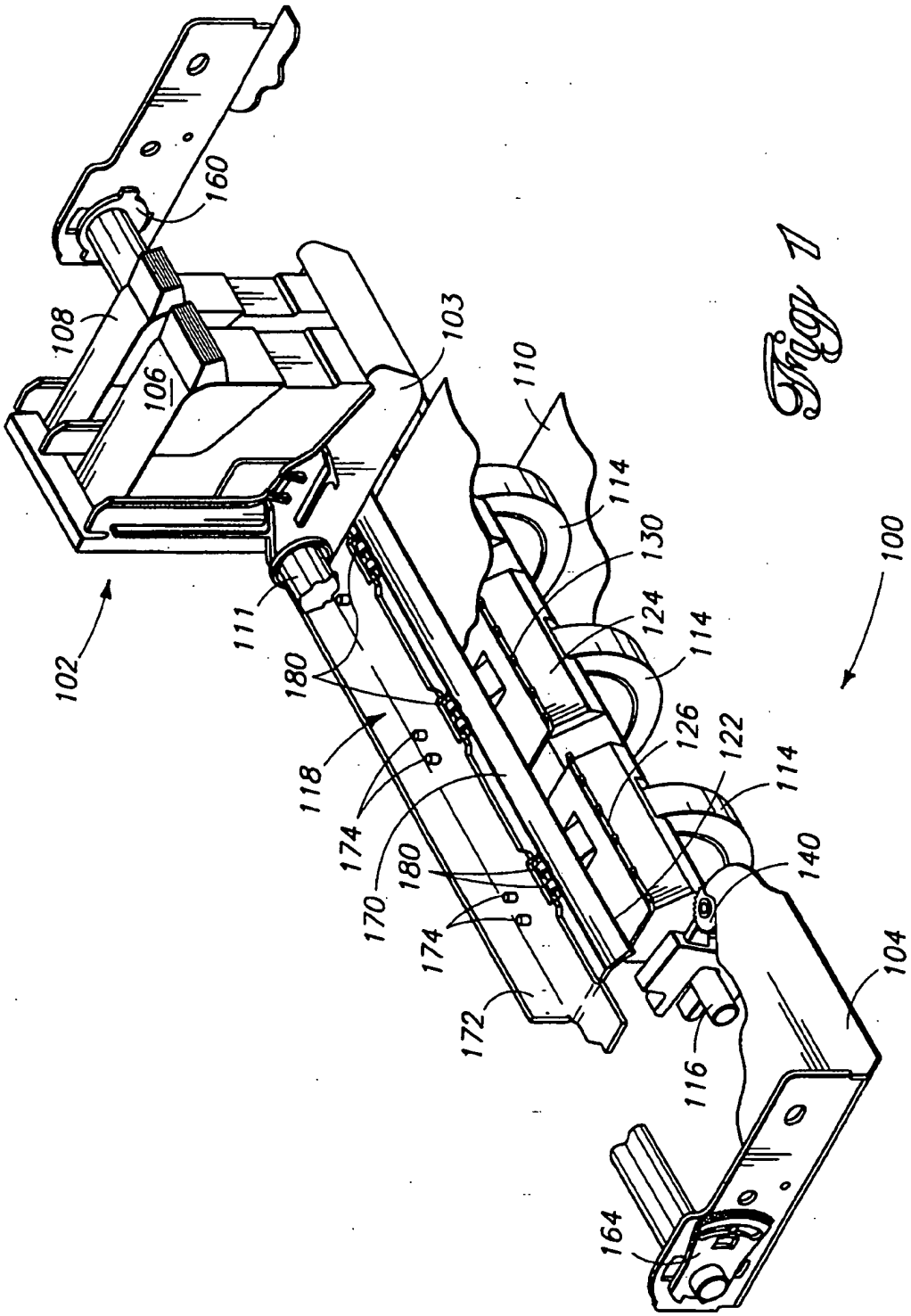

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Fig. 1

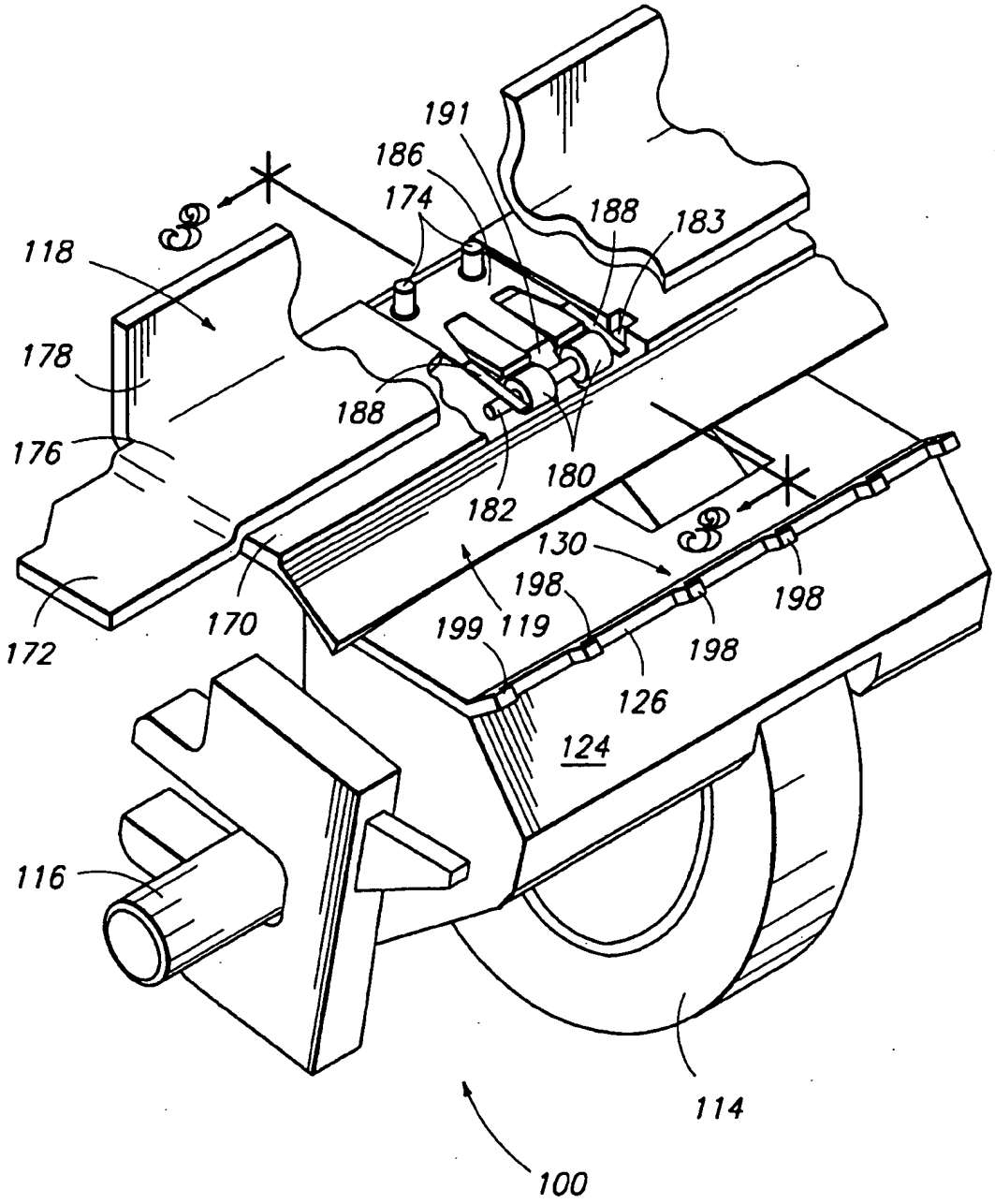
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Fig 2

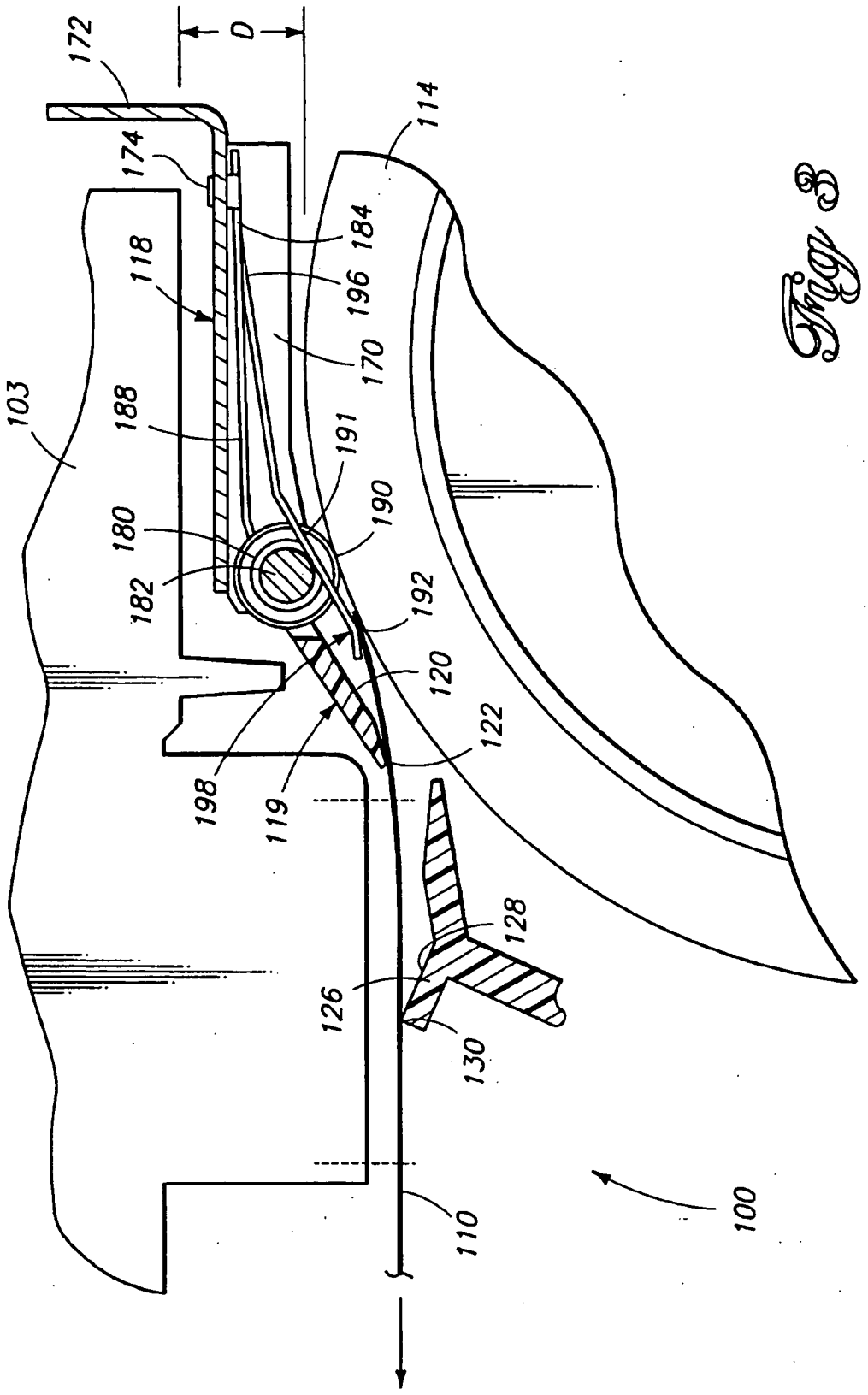
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Fig 3

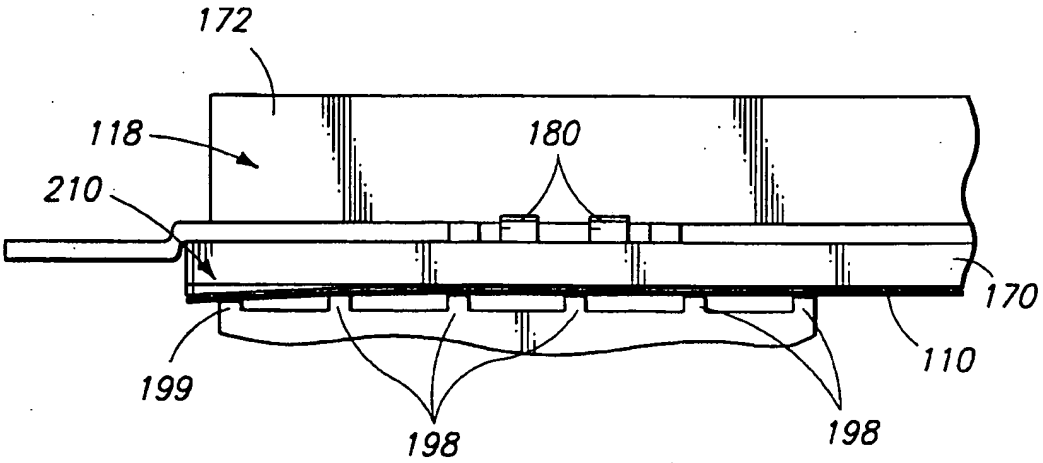

Fig 4

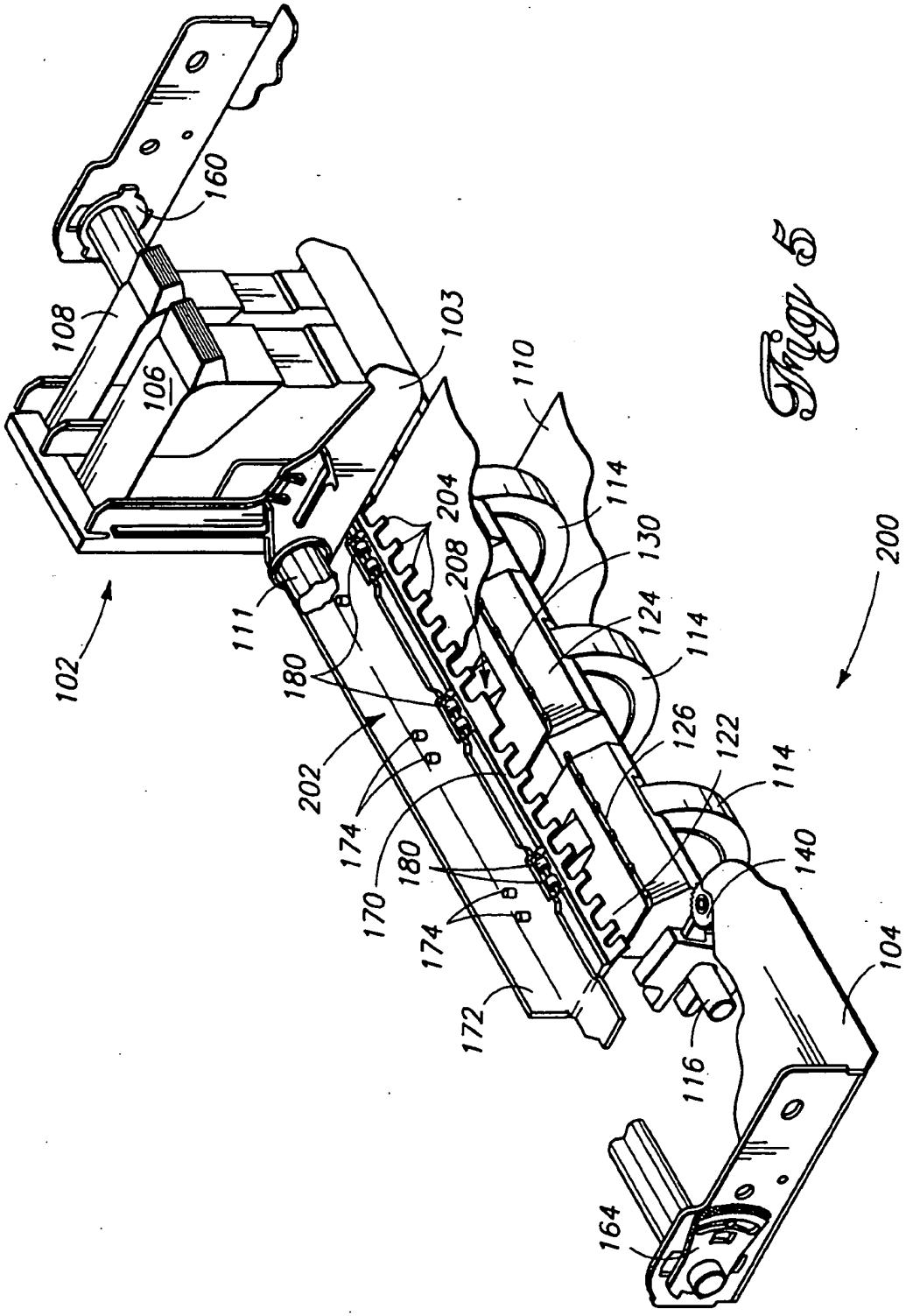
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Fig. 5

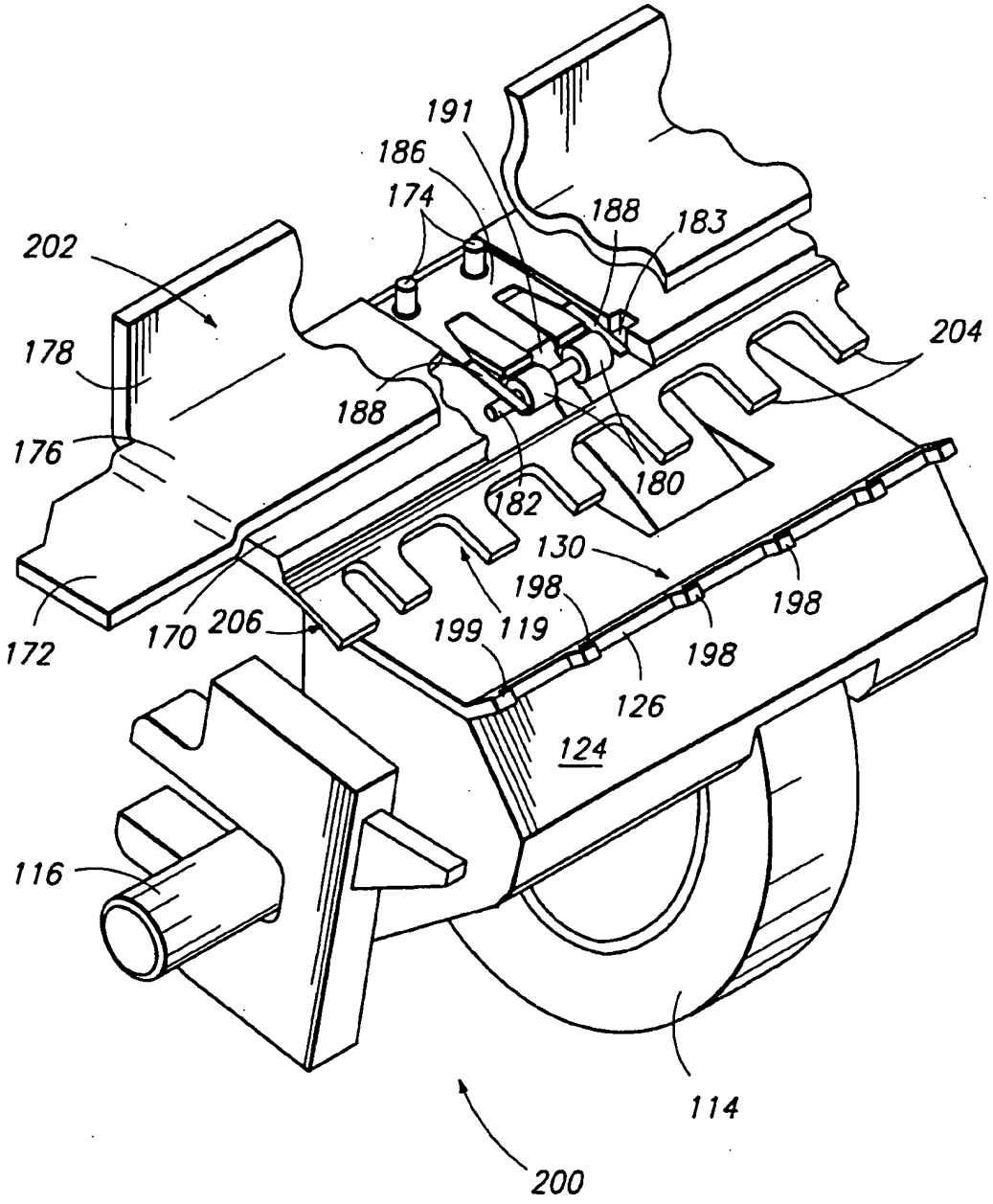
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Fig 6

MEDIA HANDLING IN AN INK-JET PRINTER HAVING GUIDE RIBS

RELATED APPLICATIONS

This application is a continuation in part of U.S. patent application Ser. No. 08/396,801, filed Feb. 28, 1995, entitled "Media Handling in an Ink-Jet Printer" now U.S. Pat. No. 5,527,123.

FIELD OF THE INVENTION

This invention relates to components within a printer for supporting a print medium such as paper through the printer's print zone and for maintaining a desired separation between the print medium and the printer's printhead.

BACKGROUND OF THE INVENTION

One very significant challenge in the design of ink-jet printers is to provide reliable paper feeding and handling. While older printers commonly use tractor-feed mechanisms, newer printers are expected to feed individual sheets of paper. This is particularly difficult with ink-jet printing since it involves the application of liquid ink directly to the paper's surface. The portions of the paper having wet ink cannot be contacted without smearing the ink. Furthermore, to apply the ink there must be an open and accessible portion of the paper which is not obstructed by paper handling components. Since it is desired to print as closely as possible to the transverse edges of the paper, and since paper widths vary, it is undesirable or impractical to grip the paper by its edges as it is being printed.

The printhead of an ink-jet printer generally comprises a plurality of nozzles aligned along the longitudinal path of the paper. The printhead is carried above the print medium path and repeatedly traverses the paper between its transverse edges. After each transverse pass of the printhead, the paper is advanced longitudinally. The area covered by a single pass of the printhead is referred to as a print zone. In order to increase printing speeds, printheads are provided with larger numbers of nozzles. This in turn increases the longitudinal dimension of the print zone associated with the printheads. As print zones become larger, however, the problems in adequately supporting paper as it passes through the print zones become greater. For example, the upper surface of the paper cannot generally be contacted as it travels through the print zone or for a short length after the print zone in which applied ink might still be wet.

Another complicating factor is the effect wet ink has on paper. The application of wet ink has a tendency to make paper bow or buckle. This effect becomes more pronounced with larger print zones, since larger areas are subject to the presence of wet ink. However, bowing to any significant degree cannot be tolerated in a high-resolution ink-jet printer. Downward bowing, away from the printhead, decreases print accuracy. Upward bowing, toward the printhead, can cause the paper to hit the printhead and to smear any applied ink. Thus, it is very desirable but also very difficult to control the precise path of paper or other print media as it passes through the print zone of an ink-jet printer.

Ink-jet printers manufactured by Hewlett-Packard Company have provided paper control through the print zone with a combination of upper and lower print media guides as described in U.S. Pat. No. 5,356,229. Paper is driven into the print zone with one or more drive rollers and associated pinch wheels. The drive rollers establish a print medium path which starts beneath the rollers, continues up around the back of the rollers, and then continues over the top of the rollers and into the print zone. The lower print media guide supports the paper from below through the print zone. An upper print media guide, positioned just upstream from the print zone, contacts the paper from above before it enters the print zone. The positioning of the components is such that the drive rollers convey the paper first in a generally downward path toward the print zone. The upper print media guide contacts the upper surface of the paper and cooperates with the drive rollers to bias the paper downwardly. Downstream from the upper print media guide, the lower print media guide contacts the paper along a transverse line beneath the print zone and biases the paper upwardly, effectively establishing a concave shape in the paper relative to the print head. The paper is desirably contacted near the print zone only by the upper and lower print media guides, and only along longitudinally-spaced lines of contact.

This configuration has been, for the most part, quite successful. However, problems do remain. Some of these problems arise because of the limited available spaces near the print zone to locate components. For instance, the upper print media guide must be very precisely located as closely as possible to the print zone. However, the printer's carriage and printhead often overhang this area. Therefore, the upper print media guide must be thinner than might otherwise be desirable for economical production with acceptable manufacturing tolerances.

Another problem is that of positioning pinch wheels over the drive rollers. Such pinch wheels would desirably be positioned to contact the drive rollers at pinch points immediately adjacent the print zone so that accurate control over the paper's longitudinal position could be achieved even when feeding the very bottom of a paper sheet through the print zone. However, this is the location occupied by the upper print media guide. Furthermore, the physical diameter of the pinch wheels limits their proximity to the print zone. As a result, the pinch points established by the pinch wheels end up being significantly upstream of the print zone, thereby reducing the capability of the printer to print on the bottom margins of paper sheets.

Control over paper edges is another problem. Even though the concave shape of the paper through the print zone reduces its tendency to bow longitudinally, applying ink at the edges of paper often causes such edges to bow upwardly. This can interfere with the printhead and cause smearing.

A further problem relates to ejection of paper from the print zone. Reliably ejecting a printed page into an output tray of a printer without damaging the printed page is critical to a printer's performance. Pages not deposited properly may be damaged by the printing mechanism as it prints the next page, may smear previously printed pages, may be dropped from the printer, or may even damage a printer's printing mechanism. A number of factors affect ejection performance, including the positions of parts within the printer's paper handling mechanism, paper type, paper orientation, print file, amount of paper curvature, and environmental conditions such as temperature and humidity.

SUMMARY OF THE INVENTION

The invention described below solves or reduces the seriousness of the paper-handling problems described above. In one aspect of the invention, an upper print media guide is formed of a molded plastic portion in combination with a metal backing plate. The plastic portion can be

economically manufactured to provide desired contours and edges for paper contact and guidance, while the metal backing plate provides structural rigidity without significantly increasing the size of the print media guide. In another aspect of the invention, a pinch finger is provided to provide a pinch point over a drive roller which is closer to the print zone than can be attained with a pinch wheel. In another aspect of the invention, paper edge control is accomplished by providing a lower support edge along the upper print media guide which bends downwardly along its outer ends. This bows the paper edges downward and reduces their tendency to interfere with the printhead.

In a further aspect of the invention, the upper print media guide has a plurality of ribs which extend downward to contact and support the paper from above. The ribs are spaced from each other so that they contact the paper only along spaced transverse portions of the paper. It has been found that this aids in ejecting the paper from the print zone.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a top perspective view of a paper support and transport mechanism and associated carriage and printhead in accordance with a preferred embodiment of the invention.

FIG. **2** is an enlarged top perspective view of a portion of the paper support and transport mechanism of FIG. **1**, shown with portions of its upper print media guide broken away.

FIG. **3** is an enlarged cross-sectional view of the paper support and transport mechanism of FIG. **1**, taken along line **3**—**3** of FIG. **2**.

FIG. **4** is a partial and enlarged front view of a portion of the paper support and transport mechanism of FIG. **1**.

FIG. **5** is a top perspective view of a paper support and transport mechanism having an alternative upper print media guide in accordance with the invention.

FIG. **6** is an enlarged top perspective view of a portion of the paper support and transport mechanism of FIG. **5**, shown with portions of the upper print media guide broken away.

DESCRIPTION OF THE INVENTION

FIGS. **1**–**4** show a print media support mechanism **100** in accordance with a preferred embodiment of the invention for supporting paper or another print medium in a printer's print zone adjacent a printhead **102**. It should be noted that although this specification repeatedly refers to "paper" and "paper" print media, the components described are also used to support other types of sheet-like media such as mylar, cardboard, envelopes, or transparencies. The term "paper" should be interpreted broadly to include such other types of sheet-like or paper-like media.

Paper support mechanism **100** and printhead **102** are mounted to a carriage plate **104** which has been broken away as necessary in the drawings to show the components discussed below. Carriage plate **104** is adapted to mount the components within a particular printer (not shown).

Printhead **102** is a color ink-jet assembly comprising a carriage **103** and a pair of cartridges **106** and **108**. Carriage **103** traverses laterally across an underlying sheet **110** of paper or other sheetlike print medium carrying a color cartridge **106** and a black cartridge **108**. Each cartridge has a plurality of nozzles (not shown) which are directed downwardly to deposit ink droplets on a top or upper surface of paper **110**. Carriage **103** is supported vertically by a carriage rod **111**. In operation, paper support mechanism **100** feeds paper **110** along a longitudinal print medium path beneath the printhead while the printhead repeatedly traverses laterally across the underlying paper, defining a laterally-extending print zone across the paper between its transverse edges. In the preferred embodiment, the print zone is approximately ½ inch in length. It is indicated generally by the dashed lines in FIG. **3**.

Paper support mechanism **100** includes means for driving a print medium along an upstream to downstream print medium path through a print zone while also supporting paper **110** in the print zone adjacent printhead **102**. In the preferred embodiment, such means includes at least one and preferably a plurality of drive rollers or drive roller tires **114** distributed laterally across the print medium path. Drive rollers **114** are mounted on a roller shaft **116** which has a longitudinal axis extending laterally or transversely across the width of the print medium path. Drive rollers **114** have rubber-like peripheries for frictional contact with paper **110** for driving paper **110** along the print medium path. Paper **110** enters the paper support mechanism beneath drive rollers **114**, wraps upward and around the rollers, and exits the support mechanism at the top of the rollers after making an approximately 180° turn. Drive rollers **114** are driven through roller shaft **116** to rotate about the longitudinal axis of roller shaft **116**. The drive rollers are mounted and positioned upstream of the print zone to feed or drive paper into and through the print zone.

FIG. **3** illustrates the positional relationship between drive rollers **114** and printhead carriage **103**. As can be seen, portions of carriage **103** traverse over the drive roller in close proximity to the drive roller, defining a very limited space between the carriage and the drive rollers.

An upper print media guide **118** is positioned in this limited space to support paper **110** from above. Upper print media guide **118** has an extending portion **119** which extends in a downward and downstream direction over paper **110** to contact paper **110** along a transverse line which is immediately upstream along the print medium path from the print zone, between the print zone and rollers **114**. More specifically, upper print media guide **118** includes an inner surface **120** which inclines or slopes downwardly from horizontal in the downstream direction of the print medium path. Inner surface **120** terminates in a lower support edge **122** which extends over the upper surface of paper **110** and which contacts and supports paper **110** from above. Lower support edge **122** is somewhat below the top edge of rollers **114** so that paper **110** is forced into a downward path as it leaves rollers **114**.

The upper print media guide in accordance with one aspect of this invention comprises two portions: a thin molded portion **170** of limited structural strength for contacting and guiding paper **110**, and an upper metal backing plate or portion **172** of greater structural strength to support and rigidify the molded plastic portion. This construction allows lower portion **170** to be inexpensively molded from plastic to obtain a desired contoured shape for contacting, supporting, and guiding paper **110**, and to have openings as needed to accommodate the drive roller and its associated parts. It would be expensive to machine these complex contour details from a stronger material such as metal. However, plastic does not provide sufficient rigidity to maintain desired tolerances while still maintaining the thinness required to fit the piece within the limited available space between carriage **103** and rollers **114**. Because the piece is thin, it tends to bow from end to end when it is mounted or suspended across the width of an underlying sheet of paper. Metal backing portion **172** remedies this deficiency in a piece which can be inexpensively stamped

and bent from sheet metal, providing accurate positioning of the complex contour details of the molded plastic portion. The two portions are ultrasonically welded together during manufacture, using rivets **174** which extend upward from molded portion **170** through corresponding apertures in backing portion **172**. Metal portion **172** preferably includes a horizontal plate **176**, to which molded portion **170** is mounted, and a rearward flange **178** which is bent at a right angle to horizontal plate **176** for adding even more strength to the structure and to eliminate any tendency of the upper print media guide to bow from end to end. Rearward flange **178** extends upwardly behind and out of the way of carriage **103**.

Paper support mechanism **100** further includes at least one and preferably a plurality of pinch wheels **180** mounted in upper print media guide **118**. The pinch wheels are arranged in pairs, with each pair being mounted on a common axle **182** (FIG. **2**) which is oriented transversely with respect to the underlying paper. Each drive roller **114** has a corresponding pair of pinch wheels **180**. Each axle includes opposite end portions which protrude transversely from opposite sides of each pair and which are received within upwardly-open slots **183** in the lower molded portion **170** of upper print media guide **118**. Spring plates **184** are mounted within upper print media guide **118**, sandwiched between its upper and lower portions, to bias the pinch wheels against their corresponding drive rollers. Each spring plate includes a rearward portion **186** having apertures through which rivets **178** are received to anchor the spring plate. Each spring plate furthermore has a pair of spring leaves **188** which extend from rearward portion **186** in a forward or downstream direction over the opposite end portions of a corresponding axle **182**. The spring leaves are bent downwardly from horizontal to exert a downward biasing force through the pinch wheels on the underlying drive rollers **114**.

Each pinch wheel is positioned to contact the print medium a first pinch point **190** near the print zone along the drive roller periphery upstream along the print medium path from lower support edge **122** of upper print medium guide **118**. The purpose and function of the pinch wheels is to maintain frictional contact between the print medium and the drive roller periphery at first pinch points **190**. Within the space and physical constraints of the overall assembly, the pinch wheels are located as closely as possible to the print zone to enable paper control as lowermost portions of paper **110** are being printed. However, the pinch wheels' diameters limit the proximity of the first pinch points to the print zone.

To enable printing nearer the bottom edge of paper **110**, the preferred embodiment of the invention includes a pinch finger **191** corresponding to each drive roller **114**. The pinch finger extends toward the print zone beneath upper print media guide **118** and beyond the pinch wheels. The pinch finger comprises an elongated leaf spring, alternatively described as a thin, flat, elongated plate of an elastic material such as spring steel. It is anchored at a proximal end **196** behind the corresponding drive roller and extends from there downstream along the print medium path to a distal portion or tip **198**. More particularly, pinch finger **191** is formed by spring plate **184** between leaf springs **188**. Its proximal end **196** is formed by rearward portion **186** of spring plate **184**. Pinch finger **191** is thus supported by and extends from upper print media guide **118** from a point upstream along the print media path relative to pinch wheels **180**. It is bent downwardly to extend between pinch wheels **180**, beneath axle **182** of print wheels **180**. The anchoring of the proximal end provides a torsioning force on the pinch finger which biases its distal portion or tip downward against the periphery of drive roller **114**, to press paper **110** against the drive roller periphery at a second pinch point **192**, and to maintain frictional contact between the drive roller and paper **110** at the second pinch point. The second pinch point at which distal portion or tip **198** contacts paper **110** is significantly closer to the print zone than first pinch points **190** created by the pinch wheels. This enables the paper to be controlled much closer to the print zone than was previously possible, and therefore allows printing much closer to the bottom edge of the paper.

Paper support mechanism **100** includes a pivot **124** which is mounted to pivot or rotate around roller shaft **116**. Pivot **124** forms a lower print media guide **126** downstream from the upper print medium guide. Lower print medium guide **126** includes an upper surface **128** (labeled in FIG. **3**) which inclines or slopes upwardly in the downstream paper direction at an adjustable angle from horizontal to an upper support edge **130** which extends laterally beneath paper **110**. Upper support edge **130** is positioned to contact paper **110** along the print medium path downstream from lower support edge **122** of upper print media guide **118**. Lower print media guide **126** pivots relative to the print zone between a non-retracted position (shown), and a retracted position (not shown). In the retracted position, pivot **124** is rotated approximately 65° (clockwise in the drawings) from the non-retracted position shown. In the non-retracted position, lower paper guide **126** contacts and supports paper **110** from below. Although not forming a part of the invention claimed herein, features of pivot **124** are described in a co-pending U.S. patent application assigned to Hewlett-Packard Company entitled "Paper Support Mechanism For Ink-Jet Printers," filed concurrently with this application, and incorporated by reference in this specification.

When pivot **124** is not retracted, drive rollers **114**, lower edge **122**, and upper support edge **130** work in combination to tension and control the elevation of paper **110** as it passes through the print zone. The print medium path extends in sequence (a) partially around and over the top of the drive rollers' peripheries, (b) between the drive rollers and the pinch wheels, (c) between the drive rollers and the distal ends of the pinch fingers, (d) away from the drive rollers, (e) beneath the lower support edge of the upper print media guide, and (f) over the upper support edge of the lower print media guide. Both lower support edge **122** and upper support edge **130** are below the uppermost elevation of the drive rollers. As paper **110** leaves drive rollers **114**, it is forced downward by lower support edge **122**. Upper support edge **130** is desirably slightly higher than lower edge **122**. The relative positioning of the components forces paper **110** through first a downward path from driver roller **114** to lower edge **122**, and then a slightly upward path from lower edge **122** to upper support edge **130**. The print medium path is thus formed in a generally concave shape beneath and relative to the print zone.

In the preferred embodiment shown, upper support edge **130** is formed by a plurality of raised ribs **198** which are distributed and spaced across the lower print media guide. This feature is described in a co-pending patent application assigned to Hewlett-Packard Company, entitled "Print Medium Handling System Including Cockle Ribs to Control Pen-To-Print Medium Spacing During Printing," filed Feb. 28, 1994, and hereby incorporated by reference. The purpose of the ribs is to allow the supported paper to buckle slightly downward between the ribs. This relieves a degree of stress which is induced in the paper during high-density printing and thereby reduces the tendency of the paper to buckle upwardly and into the printhead.

The invention further includes means for bowing the print medium downwardly at each of its transverse edges in the print zone. It has been found that this reduces the tendency of the print medium transverse edges to bow or buckle upwardly and to thereby interfere with the printhead. In the preferred embodiment, this function is performed by inclining end portions of lower support edge **122** downwardly over the transverse edges of paper **110**. More specifically, lower support edge **122** has a central segment and two end segments. The end segments are positioned over the transverse edges of the underlying paper. To bow the paper edges downwardly, the end segments are lower than the central segment. This can be seen most clearly in FIG. **4**, which shows one side of lower support edge **122**. As shown, in the preferred embodiment both the central segment and the end segments of the lower support edge are straight. However, the end segments (one of which is labeled with reference numeral **210** in FIG. **4**) are angled downwardly from the central segment over the transverse edges of the paper to bow the edges of the paper.

The means for bowing the transverse edges of paper **110** further comprises modifications to upper support edge **130**. Similarly to lower support edge **122**, upper support edge **130** can be thought of as having a central segment and two end segments positioned beneath the transverse edges of paper **110**, wherein the end segments are lower than the central segment to allow the paper to bow downwardly at its transverse edges in the print zone and to further reduce the tendency of the paper edges to interfere with the printhead. In the preferred embodiment already described, the upper support edge is formed by raised ribs **198**. These ribs include end ribs **199** (only one of which is visible in the drawings) toward each transverse end of the lower print media guide, positioned generally beneath the transverse edges of the paper. The lower positioning of the end segments in the lower print media guide is accomplished by positioning end ribs **199** lower than the rest of raised ribs **198** as shown in FIG. **4**. As shown, paper **110** bows downwardly at its transverse edges because of the unique configuration and shape of upper and lower paper guides **118** and **126**.

In some cases it may be found that the aggressive paper shaping and control resulting from the structures described above inhibits ejection of printed pages. In the mechanism described above, paper is ejected by drive roller **114** and pivot **124**. After the last line of a paper sheet is printed, the paper is advanced to the eject position by rotating the drive roller. The pivot is then rotated downward to its retracted or lowered position while the drive roller is still rotating, thereby allowing the trailing edge of the paper to fall onto the front surface of the drive roller to be pushed from the support mechanism.

In support mechanism **100**, the curvature imposed on the paper can tend to make the paper stick to the upper print media guide. This prevents the paper from falling onto the drive roller and from being properly ejected. Other facters which can keep the paper from ejecting properly are electrostatic attraction between the paper and the upper print media guide, air flow produced by the drive rollers pushing the paper upward, and conditions on the trailing edge of the paper which do not allow the paper to properly engage the drive rollers.

FIG. **5** shows an improved support mechanism **200** which reduces the tendency for the paper to stick to the upper print media guide. Other than the upper print media guide, the components of FIG. **5** are identical to those of FIG. **1**, and have therefor been labeled identically.

The improved print medium support mechanism of FIG. **5** includes an upper print media guide **202** having a plurality of ribs **204** positioned relative to the print zone to contact and support the print medium from above. Ribs **204** are spaced from each other so that they contact the print medium only at spaced transverse intervals across the print medium.

Similarly to the upper print media guide described above, upper print media guide **202** has an extending portion **206** which extends in a downward and downstream direction over paper **110** to contact paper **110** along a transverse line or support edge which is immediately upstream along the print medium path from the print zone, between the print zone and rollers **114**. In this case, however, notches are formed in extending portion **206** to serrate the support edge and to form the ribs **204**. The notches are preferably 0.5 mm wide and 4.5 mm deep, spaced to leave ribs of approximately 4 mm wide. Two notches are omitted in the preferred embodiment. The positions where these notches would otherwise be correspond to the transverse position of envelope edges passing through the support mechanism. Omitting the notches in these locations has been found improve the ability of the paper support mechanism to transport envelopes without damage. Reference numeral **208** designates a position where a notch has been omitted.

The ribs can be formed in different ways, such as by forming grooves along the inner surface of upper print media guide **202**. Such grooves are optimally 1 mm wide, 0.5 mm deep, and spaced on 2 mm centers. Alternatively, raised ribs can be molded on the inner surface of upper print media guide **202**. Such raised ribs are optimally 0.4 mm thick and 2 mm wide. A minimum of three such ribs provides improvement in ejection performance. Seven to ten ribs are preferably spaced across the page width.

The ribs form an intermittent or serrated lower support edge. This feature improves paper ejection by reducing the tendency of the paper to stick to the upper print media guide after the trailing end of the paper has emerged from the pinch point formed by pinch finger **191** against drive roller **114**. This result is obtained in part because of the reduced static electricity buildup resulting from the reduced surface contact between the upper print media guide and the paper. In addition, the ribs allow airflow over the upper side of the paper. This reduces the tendency for airflow generated by the rotating drive rollers to lift the trailing edge of the paper toward the upper print media guide.

Serrating the lower support edge also reduces its tendency to physically restrain longitudinal movement of the paper. One reason for this is that the reduced surface contact results in less friction between the upper paper support and the paper. Another reason is that the intermittent lower support edge allows the trailing edge of the paper to assume a relaxed curvature, thereby reducing any tendency for irregularities in the paper edge to catch or hang up on the lower support edge of the upper print media guide.

In addition, the serrations tend to produce slight periodic curvatures or corrugations across the trailing edge of the paper as it exits the paper handling mechanism. The lower portions of these corrugations tend to engage the drive rollers better than a completely straight trailing edge.

As already disclosed, it is desirable to bow the paper downwardly at its outer edges. This is accomplished in the embodiment of FIG. **5** by making the outer ribs lower than the central ribs. Preferably, the upper print media guide has a lower support edge with an intermittent contour similar to the continuous contour shown in FIG. **4**.

The invention includes both the system and components described above, as well as methodical steps of implementing the invention. For instance, the invention includes

methodical steps of driving a print medium into a print zone of a printer and of supporting the print medium through the print zone beneath a printhead. Preferred methodical aspects of the invention include positioning a pinch wheel to contact the print medium at a first pinch point along a drive roller periphery near the print zone and biasing a pinch finger against the print medium at a second pinch point which is closer to the print zone than the first pinch point. Preferred methodical steps also include bowing the print medium downwardly at its transverse edges through the print zone. Further methodical aspects of the invention include constructing an upper print media guide as a two-piece assembly with a molded portion for paper contact and guidance and an upper backing portion for rigidity.

The invention results in significant improvements in paper control prior to and through a printer's print zone. Because of the pinch finger, paper control is maintained even when printing bottom margins of a sheet. Bowing outside edges of the paper through the print zone allows high-density printing to be performed on the paper edges without edge buckling. The unique upper print media guide construction allows the shape of the guide to be controlled and maintained very precisely which in turn increases the accuracy with which paper is positioned relative to the print zone.

In compliance with the statute, the invention has been described in language more or less specific as to structural and methodical features. It is to be understood, however, that the invention is not limited to the specific features described, since the means herein disclosed comprise preferred forms of putting the invention into effect. The invention is, therefore, claimed in any of its forms or modifications within the proper scope of the appended claims appropriately interpreted in accordance with the doctrine of equivalents.

What is claimed is:

1. A print medium support mechanism for supporting a sheetlike print medium in a printer's print zone, comprising:

an upper print media guide;

the upper print media guide having a plurality of ribs positioned relative to the print zone to contact and support the print medium upstream of a print zone from above, the ribs being spaced from each other to contact the print medium only at spaced transverse intervals across the print medium;

a lower print media guide downstream from the upper print media guide to contact and support the print medium from below.

2. A support mechanism as recited in claim **1**, the upper print media guide comprising an extending portion that inclines downwardly to terminate at a lower support edge, the extending portion having notches that form the ribs.

3. A support mechanism as recited in claim **1**, the lower print media guide having a plurality of ribs that contact the print medium from beneath.

4. A support mechanism as recited in claim **1**, the ribs including outer ribs and central ribs, the outer ribs being lower than the central ribs to bow the print medium downwardly at each of its transverse edges as it enters the print zone.

5. A print medium support mechanism for supporting a sheetlike print medium in a printer's print zone, comprising:

at least one drive roller positioned upstream from the print zone of the printer to feed a sheetlike print medium into the print zone;

an upper print media guide positioned upstream from the print zone;

the upper print media guide having a plurality of ribs positioned relative to the print zone to contact and support the print medium upstream of a print zone from above, the ribs being spaced from each other to contact the print medium only at spaced transverse intervals across the print medium;

a lower print media guide downstream from the upper print media guide to contact and support the print medium from below.

6. A support mechanism as recited in claim **5**, the upper print media guide comprising an extending portion that inclines downwardly to terminate at a lower support edge, the extending portion having notches that form the ribs.

7. A support mechanism as recited in claim **5**, the lower print media guide having a plurality of ribs that contact the print medium from beneath.

8. A support mechanism as recited in claim **5**, the ribs comprising outer ribs and central ribs, the outer ribs being lower than the central ribs to bow the print medium downwardly at each of its transverse edges as it enters the print zone.

9. A support mechanism as recited in claim **5**, wherein the drive roller has a rotational axis, the lower print media guide pivoting about said rotational axis.

10. A support mechanism as recited in claim **5** and further comprising a pinch finger supported by the upper print media guide to extend toward the print zone, the pinch finger having a distal tip which is biased against the drive roller to maintain frictional contact between the drive roller and the print medium.

11. A support mechanism as recited in claim **5** and further comprising:

at least one pinch wheel mounted in the upper print media guide, the pinch wheel being biased against the drive roller to maintain frictional contact between the drive roller and the print medium at a first pinch point, the pinch wheel having a diameter which limits the proximity of the first pinch point to the pinch zone;

a pinch finger supported by the upper print media guide to extend toward the print zone beyond the pinch wheel, the pinch finger having a distal tip which is biased against the drive roller to maintain frictional contact between the drive roller and the print medium at a second pinch point which is closer to the print zone than the first pinch point.

12. A support mechanism as recited in claim **5**, the upper print media guide comprising a molded plastic portion for contacting and guiding the print medium and an upper metal backing portion having greater structural strength than the molded plastic portion to support and rigidify the molded plastic portion.

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